New species of marine nematodes from Loch Ewe, Scotland

H. M. Platt

Department of Zoology, British Museum (Natural History), Cromwell Road, London SW7 5BD

Z. N. Zhang

Shandong College of Oceanography, Qingdao, Shandong Province, People's Republic of China[1]

Introduction

During an investigation of the shallow sublittoral nematode fauna off a small sandy bay in Scotland one of us (Z.N.Z.) encountered a number of previously undescribed species. These were studied in detail at the British Museum (Natural History) and we here present descriptions of six of the more interesting species: *Gerlachius novusetosus, Catanema macintyrei, Catanema smo, Ceramonema yunfengi, Acantholaimus ewensis* and *Rhips paraornata.* A new diagnosis is given for the subfamily Gerlachinae Andrassy, 1976. The genus *Robbea* Gerlach, 1956 is synonymized with *Catanema* Cobb, 1920; a new generic diagnosis and a key to the species is given. Keys are also provided for the genera *Ceramonema* Cobb, 1920 and *Acantholaimus* Allgen, 1933. Several other minor nomenclatorial changes are suggested. Species belonging to these five genera have not been found previously in British waters and *Rhips* Cobb, 1920 has not previously been recorded from Europe.

Material and methods

All specimens came from the same place; sublittoral sand in 3 m of water off 'north beach', Firemore Bay, Loch Ewe, Wester Ross, Scotland. Detailed descriptions of the bay and its fauna can be found in Steele & Baird (1968), McIntyre & Eleftheriou (1968) and McIntyre & Murison (1973). The glycerine mounted specimens were studied using a Leitz Ortholux II microscope equipped with differential interference contrast facility. All drawings were made using a drawing tube. The formulae used for the dimensions are a modification of Filipjev's (1918) formula and the de Man ratios, as described in Platt (1973). The abbreviations 'S' and 'V' are the spicule length and the relative position of the vulva respectively. The abbreviations 'a.b.d.' and 'c.d.' are the anal (or cloacal) body diameter and corresponding (body) diameter. Type material has been deposited at the British Museum (Natural History).

Systematic descriptions

The classification follows that given in Gerlach & Riemann (1973).

Subfamily **GERLACHINAE** Andrassy, 1976

DIAGNOSIS. Meyliidae. Cuticle smooth or feintly striated. Amphids circular, lightly cuticularised or invisible. Testes paired, opposed. Ovaries reflexed.

[1]also, D.A.F.S. Marine Laboratory, Victoria Road, Aberdeen AB9 8DB

Bull. Br. Mus. nat. Hist. (Zool.) **42** (4) : 227–246

Issued 24 June 1982

DISCUSSION. Andrassy (1976) erected the genus *Gerlachius* to distinguish *Meylia lissa* Gerlach, 1956 from the other two species of the genus, *M. alata* Gerlach, 1956 and *M. spinosa* Gerlach, 1956. According to Andrassy, *Gerlachius* is characterized by its smooth cuticle and invisible amphids: the specimens described below are similar to *G. lissus* in many respects apart from these two main generic characters. However, the cuticle in *G. novusetosus* sp. nov. was observed under interference contrast and can otherwise be seen only as feintly striated so that this feature may have been overlooked in *G. lissus.* Likewise, the amphid may have been overlooked, since in the male *G. novusetosus* sp. nov. it was difficult to distinguish. Therefore, at this stage we prefer simply to widen the subfamily and genus diagnosis to permit forms with a smooth cuticle without amphids until these animals become better known.

The subfamily Gerlachinae can now be distinguished from Meyliinae since the ovaries are outstretched in the latter (Lorenzen, 1981) but reflexed in the former.

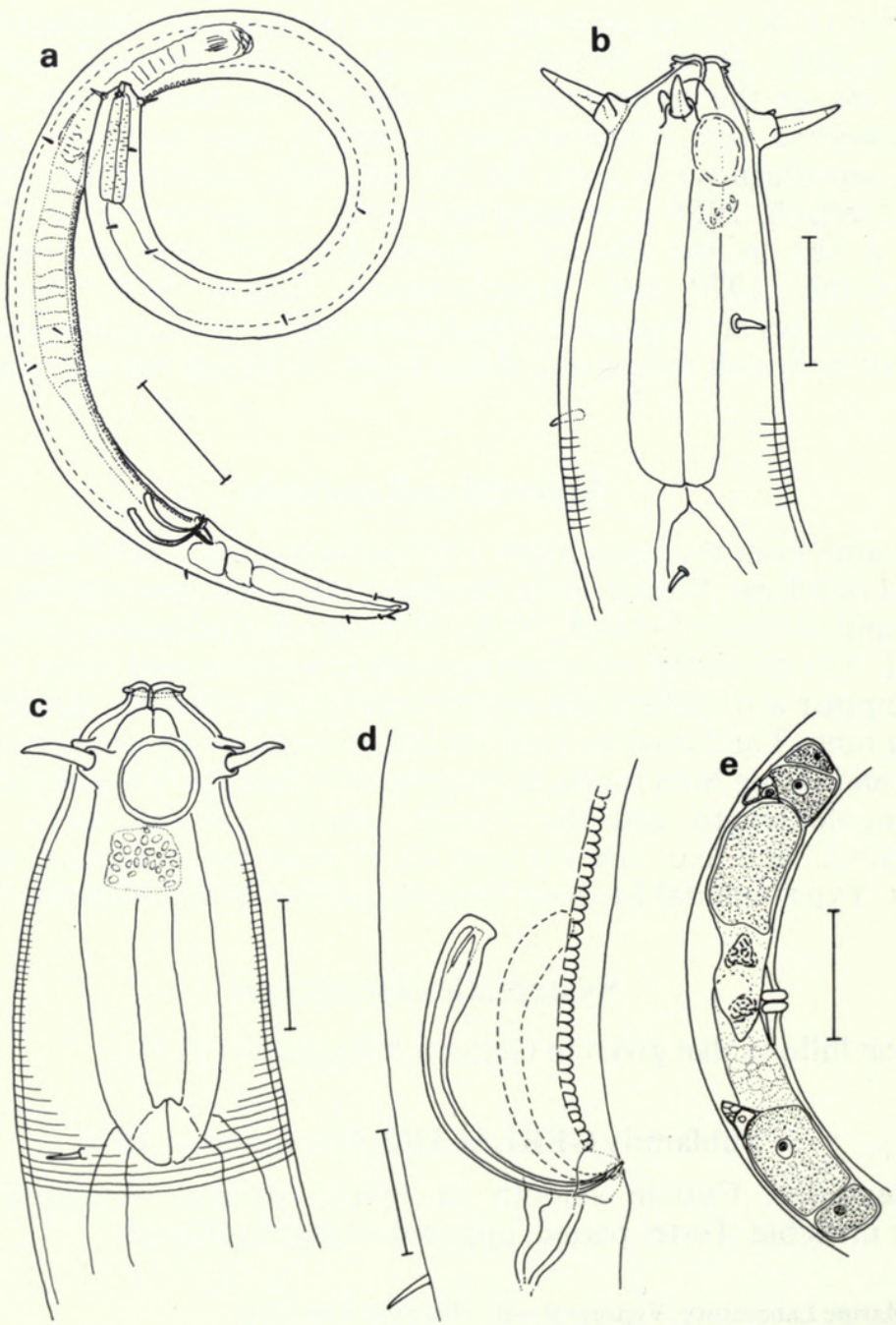

Fig. 1 *Gerlachius novusetosus*: (a) whole body of ♂; (b) head of ♂; (c) head of ♀; (d) copulatory apparatus of ♂; (e) ♀ reproductive system. Bar scales: a,e = 40 μm; b,c,d = 10 μm.

Gerlachius novusetosus sp. nov.

Fig. 1

MATERIAL STUDIED. Holotype: ♂ BM(NH) 1981.4.10.
Allotype: ♀ BM(NH) 1981.4.11.

DIMENSIONS.

Holotype ♂:	$\frac{-\ 34\ \ M\ 433}{11\ 18\ \ 22\ \ 17}$	505 μm; a = 23; b = 14·9; c = 7·0; S = 31 μm
Allotype ♀:	$\frac{-\ 34\ 280\ 463}{12\ 22\ \ 27\ \ 17}$	515 μm; a = 19; b = 15·1; c = 9·9; V = 54%

DESCRIPTION. Short, relatively stout body. Cuticle feintly striated. Short 2·5–3·5 μm sublateral somatic setae present (Fig. 1a): they are not bilaterally symmetrical. Four 5·5 μm submedian cephalic setae (R3?) seated on short 1·5 μm peduncles. A short stout additional seta, 2–2·5 μm long, is associated with each cephalic seta positioned as shown in Fig. 1b, c. Amphid round, not strongly cuticularised, 7 μm long and 6·5 μm wide in female (male amphid less distinct but about 5·5 μm long). Posterior to the amphid there is a subcuticular reticulate structure (Fig. 1c) of unknown function. Buccal cavity absent. Oesophagus short, without a bulb. Tail conical, 3–4 a.b.d. Three conspicuous caudal glands lying entirely in the tail.

Spicules curved and slightly cephalate proximally: chord length 23 μm, arc length 31 μm. Gubernaculum has a dorso-caudally directed apophysis. Anterior to cloaca the cuticle striations are thickened ventrally to produce a longitudinal row of contiguous pegs which extends about 190 μm from the cloaca (Fig 1a, d). Testes paired, opposed.

Vulva cuticularised and prominent. Ovaries paired, opposed, reflexed.

DIFFERENTIAL DIAGNOSIS. *Gerlachius novusetosus* sp. nov. differs from the only other species, *G. lissus* (Gerlach, 1956) in having four short additional cephalic setae, shorter cephalic setae (5·5 μm vs 15 μm), shorter oesophagus (b = 15 vs 7) and precloacal cuticular differentiation.

DISCUSSION. The reticulate organ posterior to the amphid and the four additional pegs alongside the cephalic setae have not been reported previously. However, this whole group of what appear to be primitive desmoscolids are poorly known, the only other records being *G. lissus* (Gerlach, 1956), *Meylia alata* Gerlach, 1956 and *M. spinosa* Gerlach, 1956; all from Kiel Bay.

CATANEMA Cobb, 1920

Robbea Gerlach, 1956 syn. nov.

The genus *Catanema* was originally described by Cobb, 1920 to accommodate *C. exile* from Jamaica, a male specimen with fine cuticle striations, narrow buccal cavity 'enclosed in a swelling', seven pairs of subventral postcloacal tubular organs, proximally cephalate spicules and a large dorso-caudally directed gubernacular apophysis. Three further species have subsequently been assigned to the genus: *C. cobbi* Inglis, 1968, with ten pairs of subventral postcloacal organs, cephalic cuticle 'modified into blocks' and a dorsally directed gubernacular apophysis; *C. porosum* Hopper & Cefalu, 1973, with five pairs of subventral postcloacal organs; *C. gerlachi* Hopper & Cefalu, 1973. This last species was a new name for a specimen from the Maldive Islands originally described by Gerlach (1963*a*) under the name *Eubostrichus exilis* (Cobb, 1920). However, as Hopper & Cefalu (1973) point out, Gerlach (1963*a*) makes no mention of the buccal bulb so characteristic of this genus and the gubernaculum lacks the prominent apophysis, which in Gerlach's specimen is thin and lies almost parallel to the spicules.

Hopper & Cefalu (1973) decided to keep this record within the genus *Catanema*. However, we feel that it is more probable that Gerlach would not have overlooked a buccal bulb if it were present (having already described nematodes with this character, e.g. *Robbea caelestis* Gerlach, 1956) so we transfer this species back to *Eubostrichus*, becoming *Eubostrichus gerlachi* (Hopper & Cephalu, 1973) comb. nov. *Eubostrichus* is characterized as having modified 'porids' on the tail (Hopper & Cefalu, 1973: porids = tubular setae serving as outlets for glands): Gerlach (1963 p. 95) depicts similar structures in both *E. parasitiferus* Chitwood, 1936 and his *E. exisis* (= *E. gerlachi*) from the Maldive Islands and both species have similarly shaped gubernacula.

In 1956, Gerlach erected the genus *Robbea* for a male specimen from Brazil, considering that the muscular buccal bulb distinguished the taxon from all other related genera. Although the type, *R. caelestis*, is certainly depicted as having a very prominent buccal bulb, some species described subsequently seem to have somewhat less prominent bulbs, depicted as similar to those described for *Catanema*. This being so, we propose to synonomize *Robbea* with *Catanema* so that *Catanema* now also includes the following species: *C. caelestis* (Gerlach, 1956), *C. gallica* (Vitiello, 1974) and *C. tenax* (Gerlach, 1963*b*). *C. gerlachi* (Boucher, 1975) was described from a female only: since male characters are of importance in this taxon, and despite the fact that *C. gerlachi* seems to be unique in the length of its subcephalic setae, we prefer to treat it as a *species inquirenda.*

In proposing this synonomy, there remains two main points to discuss: the amphid of the type and the presence of subventral tubular supplements on the male tail. In Cobb's (1920) description of the type, *C. exile*, he describes the amphids as 'minute labial tubes'. However, he also states that they were 'forward-pointing . . . difficult to see'. A similar anterior position was found in *C. smo* sp. nov. described here and we feel confident that Cobb misinterpreted what were spiral, albeit minute, amphids. Cobb (1920) also depicted the type with seven prominent pairs of subventral tubular supplements on the tail, similar to the modified porids found in *Eubostrichus.* We cannot be sure whether these supplements, found in *C. exile, C. cobbi* and *C. porosum* are homologous with the stout caudal setae described in *C. caelestis, C. gallica, C. tenax* and the two new species described here. However, their presence or absence seems to be no more significant a reason for suggesting a generic split than say the presence of huge cervical suckers in *C. tenax* or the reticulate head of *C. cobbi*. Therefore, we consider the presence or absence of caudal supplements as a variable infrageneric character.

Finally, we would comment on the arrangement of setae on the head. Inglis (1968) described 6 + 4 cephalic setae, the lateral components of the R_2 circle being 'markedly dorsal' in position (although, according to the direction of the amphid spiral, he mistook ventral for dorsal). However, in most species, there are four prominent setae, often longer than the others; we judge these to be the four R_3 sensilla. The six R_2 sensilla are small in size, often not depicted but can be clearly seen in the two species described here. If so, the R_1 sensilla must be reduced to papillae and may require SEM to resolve. In all species, each R_3 sensillum seems to be accompanied by a more medially situated subcephalic seta, which may be at about the same level as the R_3 sensilla as in *C. tenax* or more posterior as in *C. caelestis*. It is these which Inglis (1968) called the four cephalic setae. In addition to these subcephalic setae, there are others on the cephalic capsule which, according to the several specimens of each species described here, seem to be quite stable in position. Most species, including *C. smo* sp. nov., have setae located either side of the base of the amphid. In at least *C. cobbi, C. macintyrei* sp. nov. and *C. tenax* there are additional setae in specific locations. For example, in *C. cobbi* there is a pair of setae either side of the base of the amphid and an additional seta associated with each ventral subcephalic seta. In *C. macintyrei* sp. nov. there is a seta close behind each subcephalic seta, a small seta associated with each ventral R_3 seta and a seta lying dorsal to the amphid.

We propose the following generic diagnosis: *Catanema.* Desmodoridae. Stilbonematinae. Elongated body. Cuticle finely striated posterior to cephalic capsule and in life covered with coccoid blue-green algae. Cephalic capsule may appear reticulate or feintly punctated. Four anteriorly directed R_3 cephalic setae and four subcephalic setae. Additional subcephalic

setae may be present on the cephalic capsule. Spiral amphid. Buccal cavity minute and funnel-shaped leading to a muscular buccal bulb. Oesophagus narrow, terminating in a rounded posterior bulb. Spicules curved and proximally cephalate. Gubernaculum with a solid dorsally or dorso-caudally directed apophysis. Single outstretched testis. Subventral pairs of tubular organs may be present on the tail. Tail conical.

TYPE SPECIES. *Catanema exile* Cobb, 1920

Key to the species of *Catanema*

1 Ventral suckers present in oesophageal and post-oesophageal region
C. tenax (Gerlach, 1963) comb. nov.
syn. *Robbea tenax* Gerlach, 1963
– Ventral suckers absent 2
2 Cephalic cuticle in conspicuous blocks. 10 pairs subventral caudal supplements
C. cobbi Inglis, 1968
– Cephalic cuticle smooth or with feint punctations 3
3 Tail tip pointed. 'a' ratio >200. Amphid large (0·7 c.d.) ***C. caelestis*** (Gerlach, 1956) comb. nov.
syn. *Robbea caelestis* Gerlach, 1956
– Tail tip rounded. 'a' ratio <200 4
4 Amphid situated far anterior so that subcephalic and subamphidal setae are on the same level. 7 pairs subventral caudal supplements . . . . . ***C. exile*** (Cobb, 1920)
– Amphid situated further posterior 5
5 Middle of amphid situated at 10% of length of buccal bulb from anterior . . ***C. smo*** sp. nov.
– Middle of amphid situated at least 30% of length of buccal bulb from anterior . . . 6
6 Cephalic setae 8 μm long (0·3 c.d. at base of buccal bulb) ***C. gallica*** (Vitiello, 1974) comb. nov.
syn. *Robbea gallica* Vitiello, 1974
– Cephalic setae >17 μm long (0·8 c.d. at base of buccal bulb) 7
7 Only 4 subcephalic setae and 4 subamphidal setae between base of amphid and anterior
C. porosum Hooper & Cefalu, 1973
– Additional subcephalic setae present . . . . . ***C. macintyrei*** sp. nov.

Catanema macintyrei sp. nov.

Figs 2–3

MATERIAL STUDIED. Holotype: δ_1 BM(NH) 1981.5.22.
Allotype: φ_1 BM(NH) 1981.5.23. Paratypes: five males and five females BM(NH) 1981.5.24–29, 31–34.

DIMENSIONS.

Holotype ♂: $\frac{-\ 87\quad M\ 3710}{25\ 25\quad 27\quad 23}$ 3770 μm; a = 142; b = 43; c = 65; S = 47 μm

Allotype φ_1: $\frac{-\ 94\ 1845\ 3555}{25\ 25\quad 29\quad 24}$ 3620 μm; a = 125; b = 39; c = 56; V = 51%

δ_2: L = 3720 μm; a = 138; b = 37; c = 66; S = 47 μm
δ_3: L = 3965 μm; a = 137; b = 42; c = 71; S = 44 μm
δ_4: L = 4170 μm; a = 143; b = 47; c = 72; S = 44 μm
δ_5: L = 3875 μm; a = 146; b = 45; c = 64; S = 43 μm
δ_6: L = 3540 μm; a = 128; b = 41; c = 61; S = 41 μm
φ_2: L = 4065 μm; a = 145; b = 47; c = 71; V = 50%
φ_3: L = 3720 μm; a = 143; b = 40; c = 69; V = 50%
φ_4: L = 4510 μm; a = 161; b = 46; c = 76; V = 52%
φ_5: L = 4010 μm; a = 143; b = 47; c = 78; V = 52%
φ_6: L = 4530 μm; a = 162; b = 49; c = 79; V = 49%

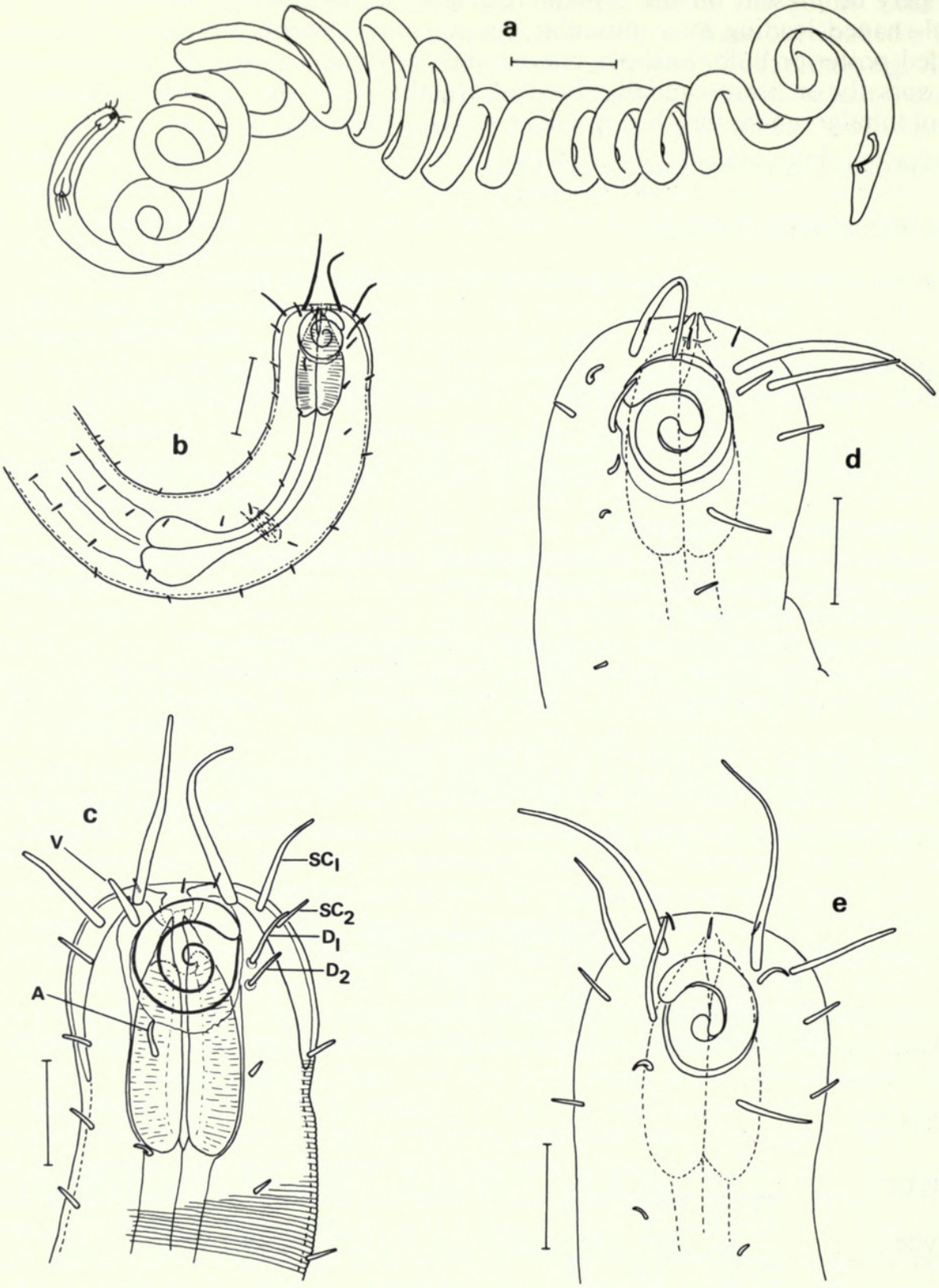

Fig. 2 *Catanema macintyrei*: (a) whole body of δ_2; (b) oesophageal region of δ_1; (c) head of δ_1 (see text for labelling); (d) head of δ_7; (e) head of φ_1. Bar scales: a = 100 μm; b = 30 μm; c–e = 10 μm.

Spicule (S) measurement is the arc. Maximum body diameter used is the average of three measurements along the middle portion of the body.

DESCRIPTION. Cuticle finely striated from the base of the cephalic capsule, but most conspicuous in the oesophageal and immediate post-oesophageal regions. Typically, the cuticle is covered with a coating of coccoid blue-green algae, but this tends to be lost during preservation. One specimen also had two suctorian ectoparasites attached to the middle part

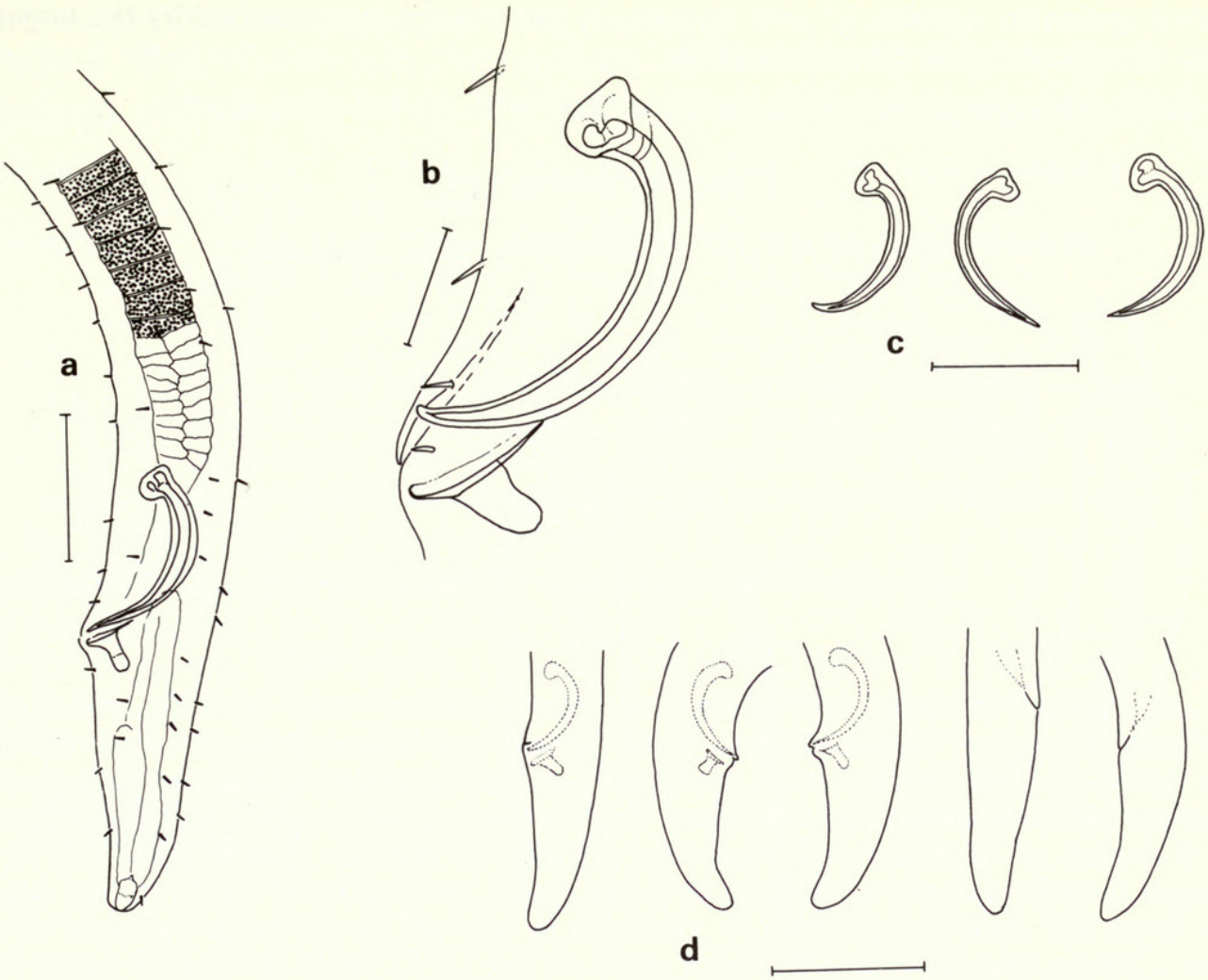

Fig. 3 *Catanema macintyrei*: (a) tail region of δ_2; (b) copulatory apparatus of δ_1; (c) spicules of three different males; (d) tails of three males and two females. Bar scales: a,c = 30 μm; b = 10 μm; d = 50 μm.

of the body. Cuticle bears six files of stout setae throughout the body, but they are particularly conspicuous ventrally in the region just posterior to the oesophagus and in the male, anterior to the cloaca. R_1 sensilla not seen. Six small 1·5–2 μm setose R_2 sensilla. Four 17·5–24 μm R_3 setae, about 80% of the maximum diameter of the cephalic capsule. The head diameter is usually measured at the level of the R_3 sensillae, but they are so far anterior as to make this measurement too inaccurate. Medial and slightly posterior to the R_3 setae are four 11–14 μm subcephalic setae (labelled SC_1 in Fig. 2c). Further posterior are four smaller 6·5–8·5 μm setae (labelled SC_2 in Fig. 2c). In addition, there is one seta just posterior to the ventral R_3 seta (Fig. 2c, V), two level with and dorsal to the middle of the amphid (Fig. 2c, D_1 & D_2) and one ventro-sublateral subamphidal seta (Fig. 2c, A). The disposition of these setae is constant in that each element can be distinguished in the same location in all the specimens, both male and female. Amphid ventrally wound, from outside to centre; 9–10 μm wide. Buccal cavity represented by a narrow funnel in the anterior part of the buccal bulb, the latter being about 23 μm long. Tail conical with a characteristic slight ventral inflection at the tip.

Spicules paired, curved and proximally cephalate: average length 44 μm (arc) or 32 μm (chord). Gubernaculum well cuticularised and dorso-caudally directed. Testis single and outstretched.

Ovaries paired and apparently outstretched.

DIFFERENTIAL DIAGNOSIS. *Catanema macintyrei* sp. nov. can be distinguished from the other species in the genus *Catanema* by the unique disposition of the setae around the head. From

the other sympatric species, *C. smo* sp. nov., it can also be distinguished by the larger and slightly more posteriorly situated amphid.

DISCUSSION. This species will be discussed together with the following species.

Catanema smo sp. nov.
Fig. 4

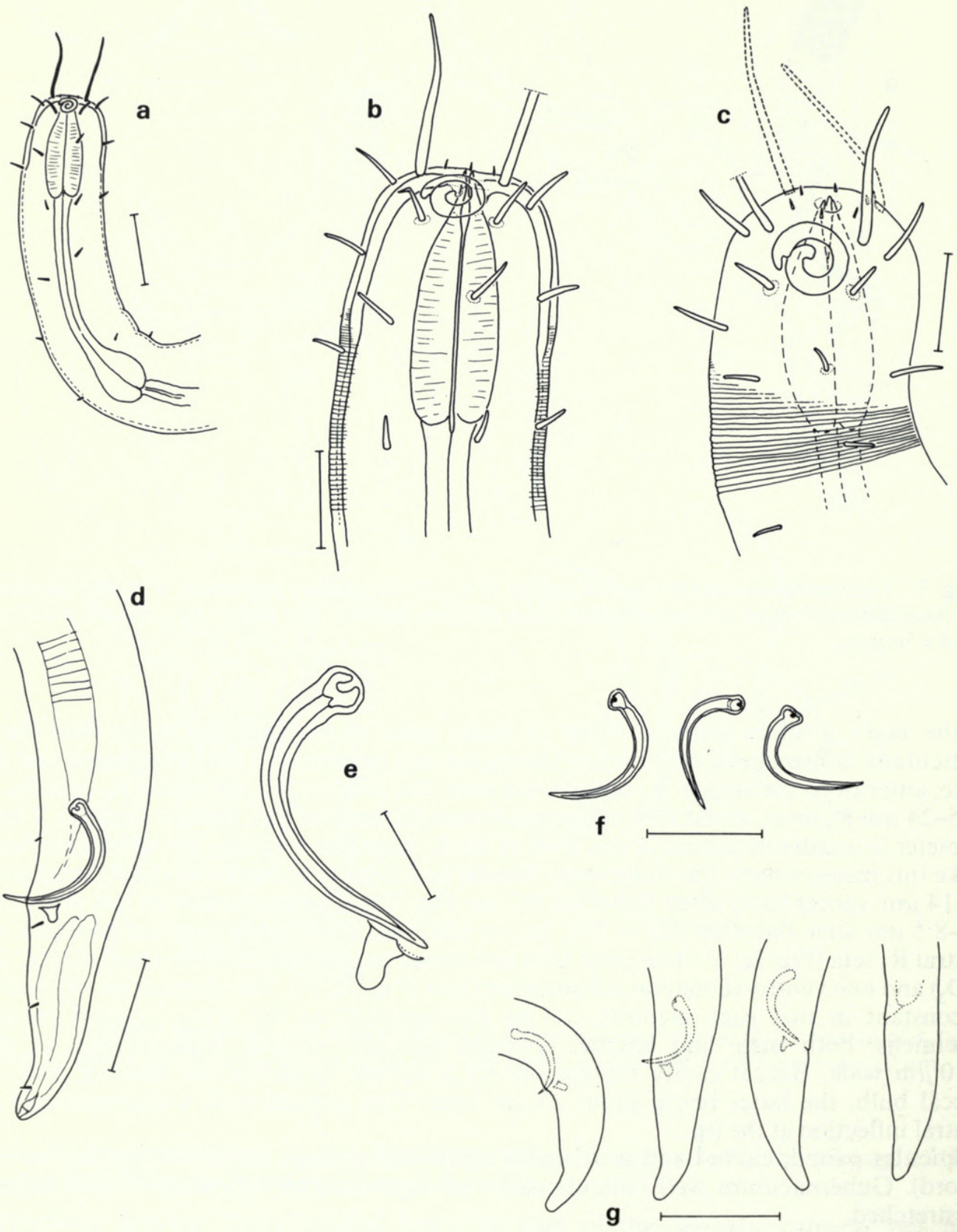

Fig. 4 *Catanema smo*: (a) oesophageal region of δ_1; (b) head of δ_1; (c) head of δ_3; (d) tail region of δ_2; (e) copulatory apparatus of δ_1; (f) spicules of three different males; (g) tails of three males and one female. Bar scales: a,d,f = 30 μm; b,c,e = 10 μm; g = 50 μm.

MATERIAL STUDIED. Holotype: δ_1 BM(NH) 1981.5.38.
Allotype: φ_1 BM(NH) 1981.5.39. Paratypes: four males BM(NH) 1981.5.35–37, 30.

DIMENSIONS.

Holotype δ_1: $\frac{-\ 83\quad M\ 2980}{24\ 24\quad 25\quad 24}$ 3050 μm; a = 122; b = 37; c = 43; S = 38 μm

Allotype φ_1: $\frac{-\ 80\ 1900\ 3393}{24\ 25\quad 29\quad 21}$ 3460 μm; a = 121; b = 44; c = 52; V = 55%

δ_2: L = 3090 μm; a = 125; b = 51; c = 54; S = 38 μm
δ_3: L = 3285 μm; a = 131; b = 40; c = 54; S = 40 μm
δ_4: L = 2864 μm; a = 110; b = 38; c = 50; S = 37 μm
δ_5: L = 3155 μm; a = 131; b = 38; c = 53; S = 30 μm

(Spicule and maximum body diameter measured as in *C. macintyrei*).

DESCRIPTION. Cuticle finely striated from the base of the cephalic capsule, but most conspicuous in the oesophageal and immediate post-oesophageal regions. Typically, the cuticle is covered with a coating of coccoid blue-green algae, but this tends to be lost during preservation. The cuticle of the cephalic capsule has a feint punctated or dotted appearance viewed with interference contrast microscopy although this is difficult to depict: it is not obvious with ordinary illumination. There are rows of setae in the oesophageal region but somatic setae are absent from the rest of the body. R_1 sensilla not seen. Six small (about 1 μm) setose R_2 sensilla. Four 17–21 μm R_3 setae, about 80% of maximum cephalic capsule diameter and situated at the anterior extremity of the head. Four shorter subcephalic setae and four sublateral subamphidal setae. This disposition of the setae on the anterior part of the head was the same in all specimens. Amphid ventrally wound, situated just posterior to the R_3 setae and 6–7 μm wide. From a lateral view, the amphid appears oval but when the head is bent slightly the amphid can be seen to be round (Fig. 4c). Buccal cavity a narrow funnel in the anterior part of the buccal bulb. Tail conical with a characteristic ventral inflection in the slightly more cylindrical terminal portion.

Spicules paired, curved and proximally cephalate: average length 36 μm (arc) or 27 μm (chord). The proximal cephalation has a characteristic knob which is easy to distinguish even at low magnification (Fig. 4f). Gubernaculum well cuticularised and dorso-caudally directed. Testis single and outstretched. Tail has three pairs of subventral setae and a single precloacal ventral seta was present in at least two males.

Ovaries paired and apparently outstretched.

DIFFERENTIAL DIAGNOSIS. *Catanema smo* sp. nov. can be distinguished from most other *Catanema* species with only four subcephalic and four subamphidal setae by the anterior position of the amphid. The only other species with its amphids so far forward is *C. exile* Cobb, 1920, which has 7 well developed pairs of tubular caudal supplements.

DISCUSSION. Superficially, both the species found in the same samples from Loch Ewe appear to be similar. However, on more detailed examination they were shown to be separate species on a number of characters. In practice, the more distinct knob at the proximal end of the spicule could be used to distinguish males of *C. smo* at relatively low magnification once the existance of two separate species was realized. Other differences include the presence of two conspicuous subamphidal setae in *C. smo*, presence of somatic setae throughout the body in *C. macintyrei* and slightly smaller spicules in *C. smo*. Both species were found mainly 9–12 cm deep in the sand, the epizoic algae being a common feature on deeper-living nematodes.

Ceramonema yunfengi sp. nov.
Fig. 5(a–d)

MATERIAL STUDIED. Holotype: ♂ BM(NH) 1981.4.12.
Allotype: $♀_1$ BM(NH) 1981.4.13. Paratype $♀_2$ BM(NH) 1981.4.14.

DIMENSIONS.

Holotype ♂:	–	181	M	1328	1560 μm; a = 78; b = 8·6; c = 11·7; S = 24 μm
	16	18	20	18	
Allotype $♀_1$:	–	125	M	791	927 μm; a = 54; b = 7·4; c = 6·8; V = 44%
	15	17	17·5	12	
$♀_2$:	–	141	M	874	1020 μm; a = 58; b = 7·2; c = 7·0; V = 46%
	16	17·5	17·5	12·5	

DESCRIPTION. Body colourless, elongated and conspicuously annulated. Cuticle annules in male 5·5 μm, 7 μm and 5 μm long in the anterior oesophagus, posterior oesophagus and cloacal regions respectively. Total number of body annules 277 in ♂, 186 in $♀_1$ and 184 in $♀_2$. Each annule divided into eight plates, so that there are eight longitudinal crests running the

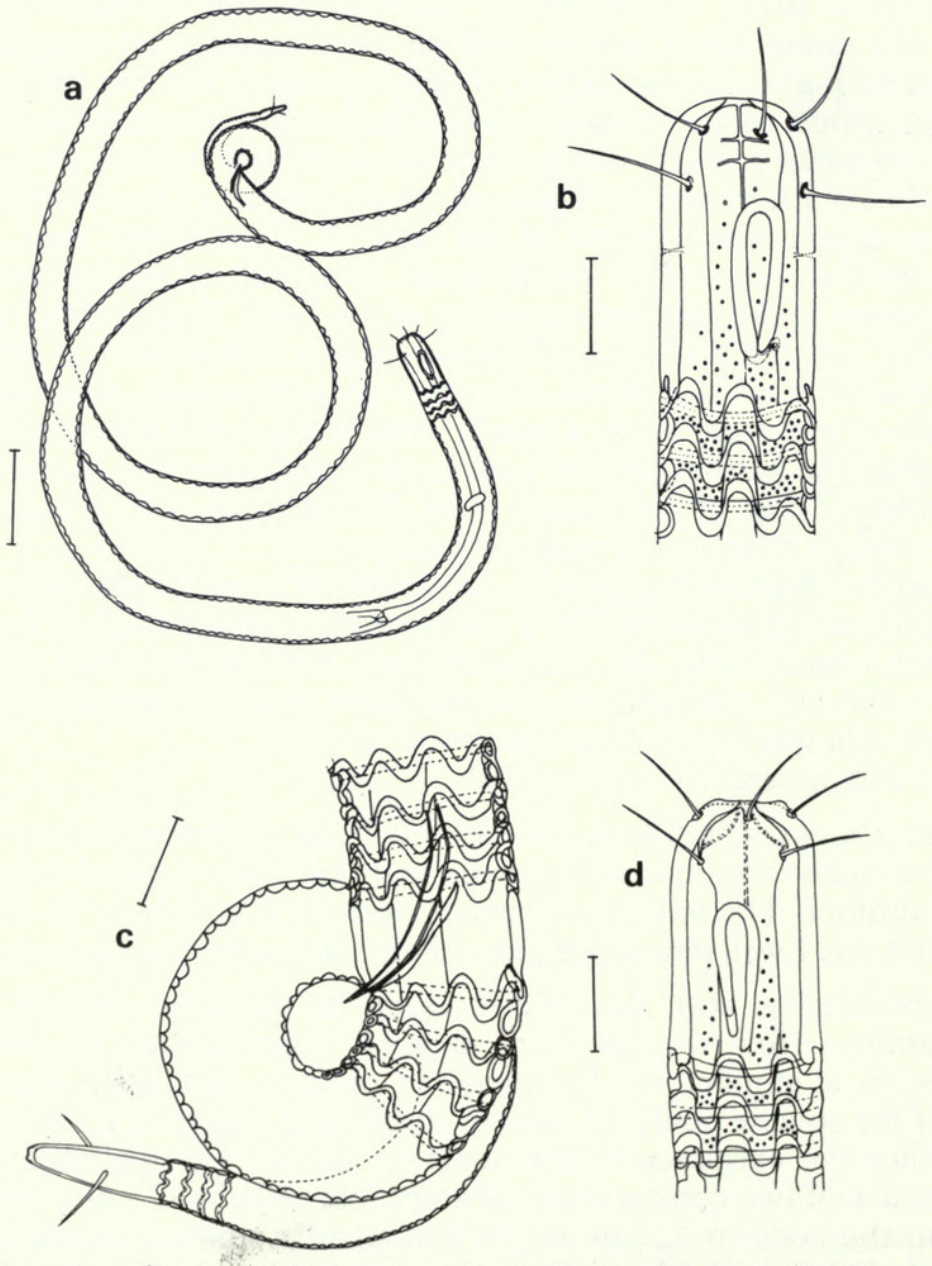

Fig. 5 *Ceramonema yunfengi*: (a) whole body of $♂_1$; (b) $♂_1$ head; (c) $♂_1$ tail; (d) $♀_1$ head. Bar scales: a = 50 μm; b–d = 10 μm.

length of the body. Vacuoles are present beneath the cuticle which are not confined to the longitudinal crests. In the male, but not the female, the annule in the cloacal region is elongated (about 12 μm) relative to the rest (Fig. 5c). Somatic setae absent except for two caudal setae situated on the distal cone of the male only. Cephalic capsule elongated: ♂ 33·5 × 16·5 μm; ♀$_1$ 29 × 15 μm; ♀$_2$ 31·5 × 16 μm. Six slim R_2 cephalic setae; 12·5 μm long in ♂ and 10–10·5 μm long in ♀♀. Four slim R_3 cephalic setae situated just posterior to R_2 setae; 13·5 μm long in ♂, 11 μm long in ♀♀. In the ♂, two medial holes in the cephalic capsule were observed just posterior to the level of the R_3 sensilla (Fig. 5b): possibly positions of subcuticular sensilla. Amphids an elongated loop, 17–19 μm long. Buccal cavity absent. Oesophagus narrow but widens slightly at the posterior end. Nerve ring at 52–54% of oesophagus length. Excretory ampullae situated anterior and posterior to oesophageal-intestinal junction. Tail elongated, 7 a.b.d. in ♂, 11–12 a.b.d. in ♀♀. In the ♂, the terminal cone is 14·5 μm long and bears two lateral 8 μm setae.

Spicules paired, slightly curved and 24 μm long (chord). Gubernaculum almost straight, 15 μm long. No supplements. Testes not clear.

Ovaries paired, opposed and reflexed.

DIFFERENTIAL DIAGNOSIS. *Ceramonema yunfengi* sp. nov. can be distinguished from all other known species of the genus by the presence of two lateral sub-terminal caudal setae in the ♂ and a relatively longer cephalic capsule. The only other species described which have an elongated cloacal annule are *C. carinatum* Wieser, 1959 and possibly, according to the figure, *C. pisanum* Gerlach, 1952. However, both these species have shorter cephalic setae and are not described as having subcuticular vacuolisation. In addition, the tail of *C. pisanum* is longer than that of *C. yunfengi* (11 a.b.d. vs. 7 a.b.d.).

DISCUSSION. Haspeslagh (1973) recently revised the superfamily Ceramonematoidea and, on the basis of the presence or absence of vacuolisation in the cuticle, divided *Ceramonema* into three genera. However, Lorenzen (1981) did not accept this argument and synonomized Haspeslagh's new genera, *Ceramonemoides* and *Cyttaronema*, with *Ceramonema*. Currently, there are eleven species contained in the genus including *C. yunfengi*, which can be distinguished using the data contained in Table 1 and Fig. 6.

Apart from *C. pisanum* Gerlach, 1952, which is described from a male and a juvenile female, *C. yunfengi* is the only species where both male and adult female characters are known. Four species are known from females only and one from a juvenile only. Many of the important characters used to distinguish marine nematodes in general are vested in the male, so current practice is to consider species described from females or juveniles only as dubious. However, it is still possible to separate the eleven species contained in Table 1 on the combination of the relative length of the cephalic capsule, presence or absence of vacuolisation and its pattern of distribution, relative position of R_2 and R_3 sensilla and cuticle structure. However, as more species become known, it may become impossible to separate the taxa on these characters alone so that *C. attenuatum, C. chitwoodi, C. rectum, C. sculpturatum* and *C. undulatum* may have to be designated species dubiae, particularly as certain characters display sexual dimorphism including length of R_2 and R_3 sensilla and number of body annules, at least in *C. yunfengi*. The apparent sexual dimorphism in the amphid reported for *C. pisanum* (Fig. 6e, f) may be simply due to the female not being adult: the amphids are similar in *C. yunfengi*.

Acantholaimus ewensis sp. nov.

Figs 7–8

MATERIAL STUDIED. Holotype: ♂$_1$ BM(NH) 1981.4.15.
Allotype: ♀$_1$ BM(NH) 1981.4.16. Paratypes: ♂$_2$ BM(NH) 1981.4.17; ♂$_3$ BM(NH) 1981.4.18; ♂$_4$, ♂$_5$ in collection of Z.N.Z.

Table I Tabular key to species of the genus *Ceramonema*

Species	sex	a	R_3 cephalic setae length	h.d.	Cephalic capsule l/w	Vacualisation +/—	Body annules	Elongated anal annule	Terminal setae	Distribution
attenuatum Cobb, 1920	♀	?	—	0·7*	1·5*	?	?	—	?	Jamaica
carinatum Wieser, 1959	♂	43	12	0·5	1·6	—	?	+	—	E. coast USA
chitwoodi De Coninck, 1942	♀	24	9	0·3	1·1	+′	111	—	?	Mediterranean
filipjevi De Coninck, 1942	♂	33	7	0·5	1·6	—	75	—	—	Mediterranean
pisanum Gerlach, 1952	♂	67	14	0·6	1·5	?	?	+?	—	Mediterranean
rectum Gerlach, 1957	♀	23	8	0·2*	1·2*	—	?	—	?	Brazil
reticulatum Chitwood, 1936	♂	52	—	0·8*	c1·2*	+	c160	—	—	E. coast USA
salsicum Gerlach, 1956	♂	38	11	0·4	1·6	+	145	—	—	Bay of Biscay
sculpturatum Chitwood, 1936	Juv.	70	—	0·5*	c1·0*	—	?	—	?	E. coast USA
undulatum De Coninck, 1942	♀	26	4	0·3	1·5	—	78	—	?	Mediterranean
yunfengi sp. nov.	♂	78	13·5	0·8	1·9	+	277	+	+	Scotland

*calculated from figure
+′vacuoles arranged under crests only

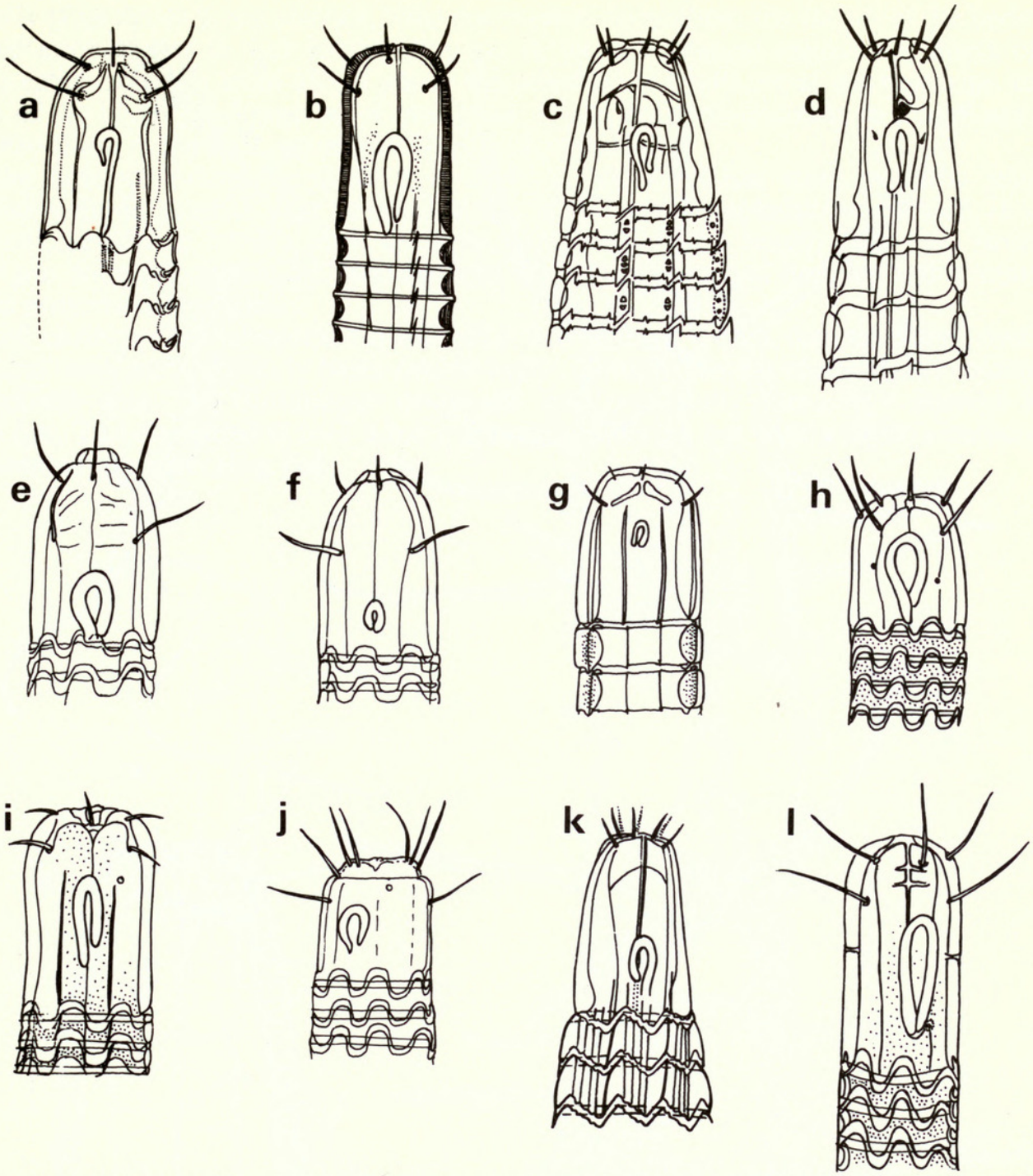

Fig. 6 Pictorial key to the species of *Ceramonema*: (a) *C. attenuatum* ♀ (after Cobb, 1920); (b) *C. carinatum* ♂ (after Wieser, 1959); (c) *C. chitwoodi* ♀ (after De Coninck, 1942); (d) *C. filipjevi* ♂ (after De Coninck, 1942); (e) *C. pisanum* ♂ (after Gerlach, 1952); (f) *C. pisanum* juvenile ♀ (after Gerlach, 1952); (g) *C. rectum* ♀ (after Gerlach, 1957); (h) *C. reticulatum* ♂ (after Chitwood, 1936); (i) *C. salsicum* ♂ (after Gerlach, 1956); (j) *C. sculpturatum* juvenile (after Chitwood, 1936); (k) *C. undulatum* ♀ (after De Coninck, 1942); (l) *C. yunfengi* sp. nov.

DIMENSIONS.

Holotype σ_1: $\frac{- \quad 115 \quad M \quad 550}{15 \quad 23 \quad 23 \quad 19}$ 780 μm; a = 34; b = 6·8; c = 3·5; S = 28 μm

Allotype φ_1: $\frac{- \quad 125 \quad 455 \quad 680}{17 \quad 25 \quad 32 \quad 23}$ 930 μm; a = 29; b = 7·4; c = 3·7; V = 49%

σ_2: L = 860 μm; a = 30; b = 7·5; c = 3·7
σ_3: L = 875 μm; a = 35; b = 7·3; c = 3·5
σ_4: L = 880 μm; a = 29*; b = 7·3; c = 4·2
σ_5: L = 935 μm; a = 25*; b = 7·5; c = 3·5
*σ_4 and σ_5 were slightly flattened.

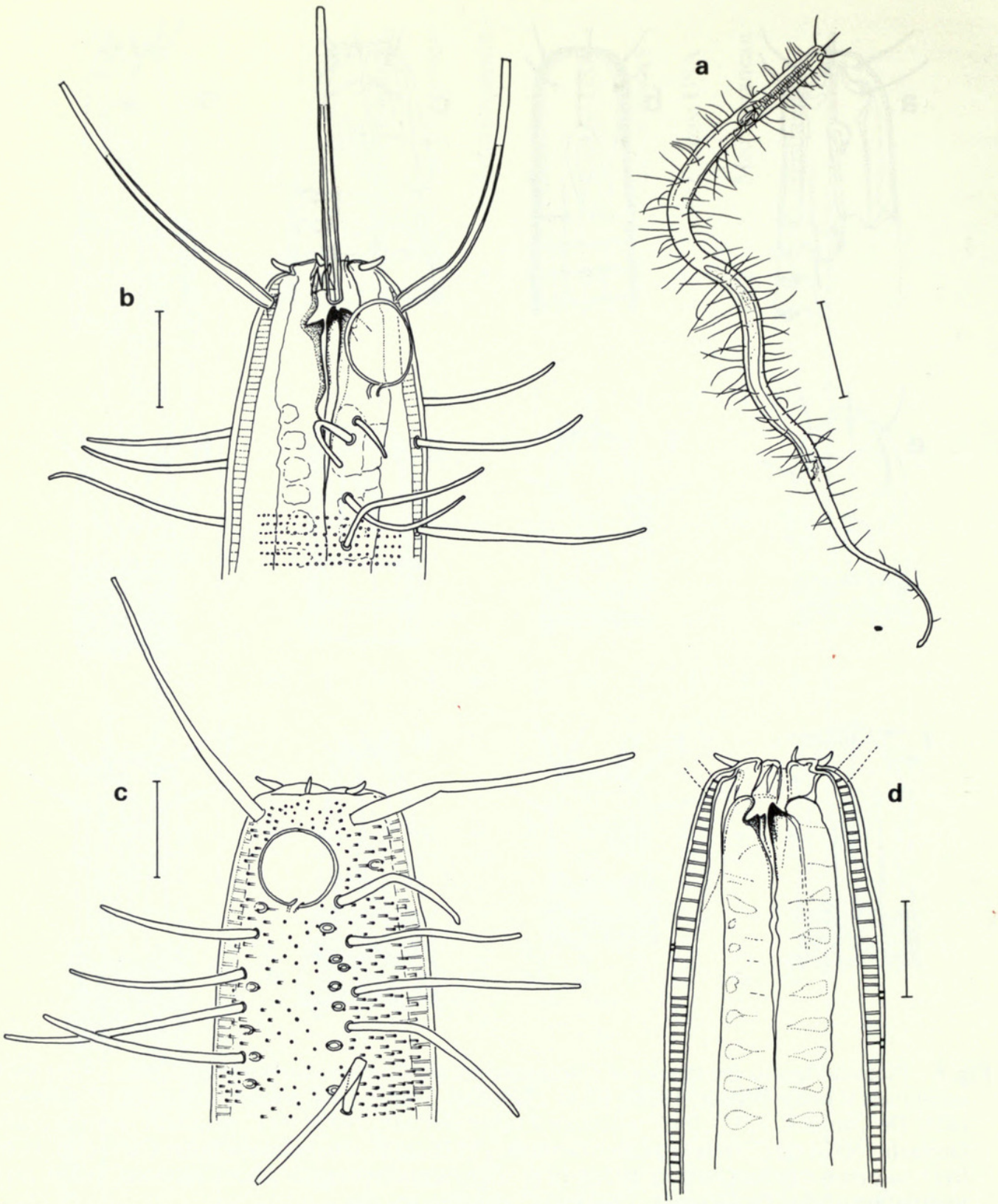

Fig. 7 *Acantholaimus ewensis*: (a) whole body of δ_1; (b) head of δ_1; (c) head of φ_1 showing surface structures only; (d) head of φ_1 showing buccal cavity structure. Bar scales: a = 100 μm; b–d = 10 μm.

DESCRIPTION. Cuticle punctated and laterally differentiated. Punctation extends anterior to amphids (Fig. 7c) and in the anterior oesophageal region the lateral punctations are irregular. Further posteriorly, the punctations become smaller and arranged in transverse rows. In the middle of the body, the transverse rows of punctations can be difficult to distinguish. Lateral differentiation consisting of two longitudinal rows of larger punctations begins level with the middle of the posterior oesophageal bulb and ends at about 65% of the tail length. The lateral rows are about 1·5 μm apart and there is a space between these rows and the transverse rows of punctations (Fig. 8f). There are four sublateral rows of hypodermal pores, which are larger

anteriorly (Figs 8d–f). Long somatic setae are present throughout the length of the body and arranged more or less in four sublateral rows. In the oesophageal region, the length of the somatic setae increases from 15–20 μm at the anterior to 35–40 μm at the posterior. In the middle of the body, the longer setae are about 45 μm long but decrease in length again to about 30–40 μm in the anal region and 10–20 μm in the tail.

At the anterior extremity there is a circle of six 2·5–3 μm stout cephalic sensilla, presumably the R_2 sensilla. Just behind are four 30–33 μm R_3 cephalic setae which, in some specimens, appear to have a joint at about two-thirds of the length (Fig. 7b). Amphids 8·5–9·5 μm wide (45–50% c.d.), circular with a well cuticularised boarder and a ventrally directed posterior inflection.

Buccal cavity rather complex but basically it is conical with a distinct dorsal and two subventral teeth and anteriorly bears twelve rugae. Oesophagus has characteristic plasmatic interruptions (Fig. 7d) throughout its length and posteriorly there is a distinct bulb, 28 × 18 μm. Tail elongated (11–12 a.b.d.), gradually tapering but with a slightly bulbous tip and a pointed spinneret (Fig. 8c).

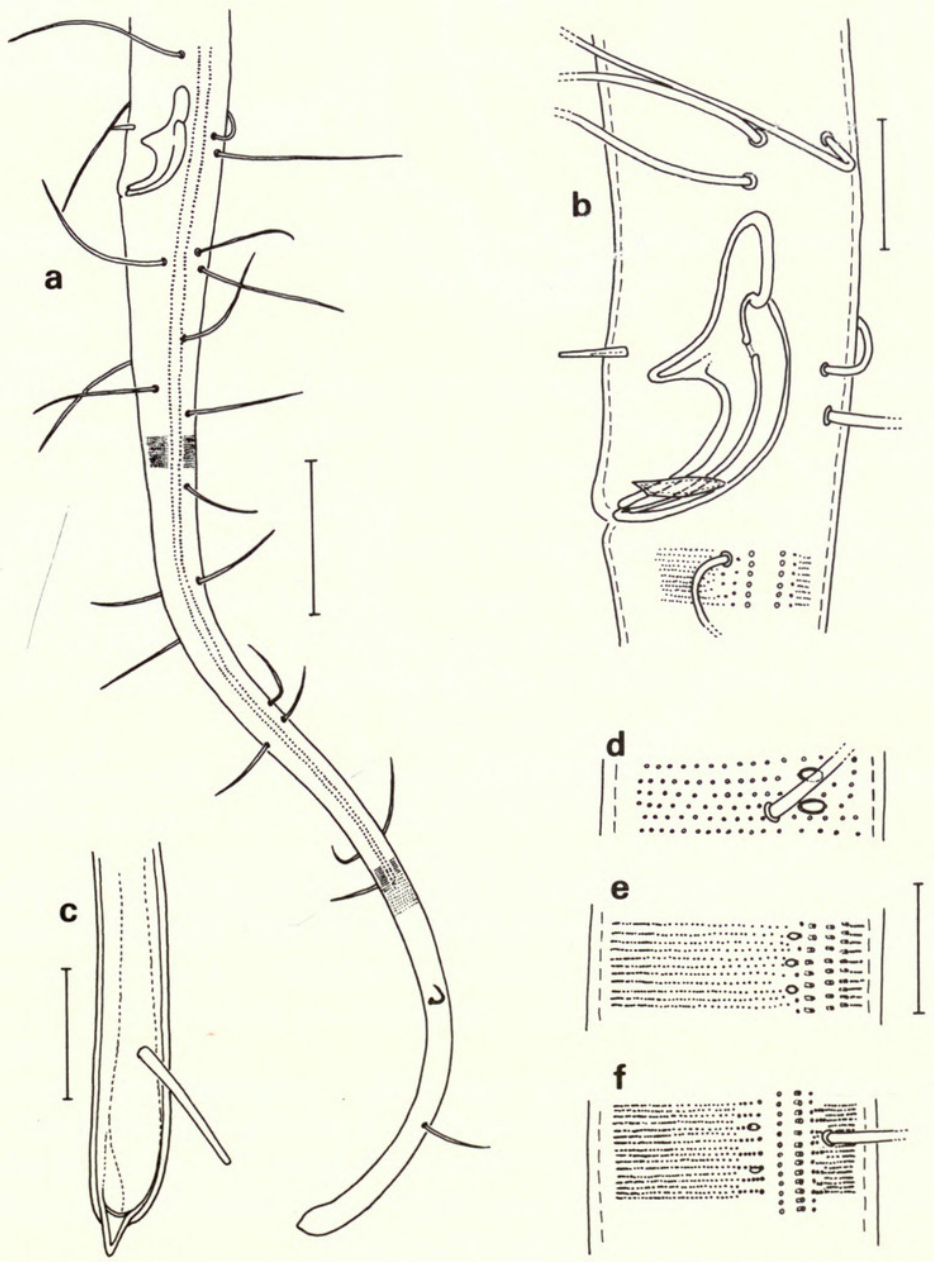

Fig. 8 *Acantholaimus ewensis*: (a) tail of δ_1; (b) copulatory apparatus of δ_1; (c) tail tip of φ_1; (d) δ_1 cuticle ornamentation about 40 μm from anterior; (e) δ_1 cuticle ornamentation level with the posterior of the oesophagus; (f) δ_1 cuticle ornamentation at middle of body. Bar scales: a = 30 μm; b–f = 10 μm.

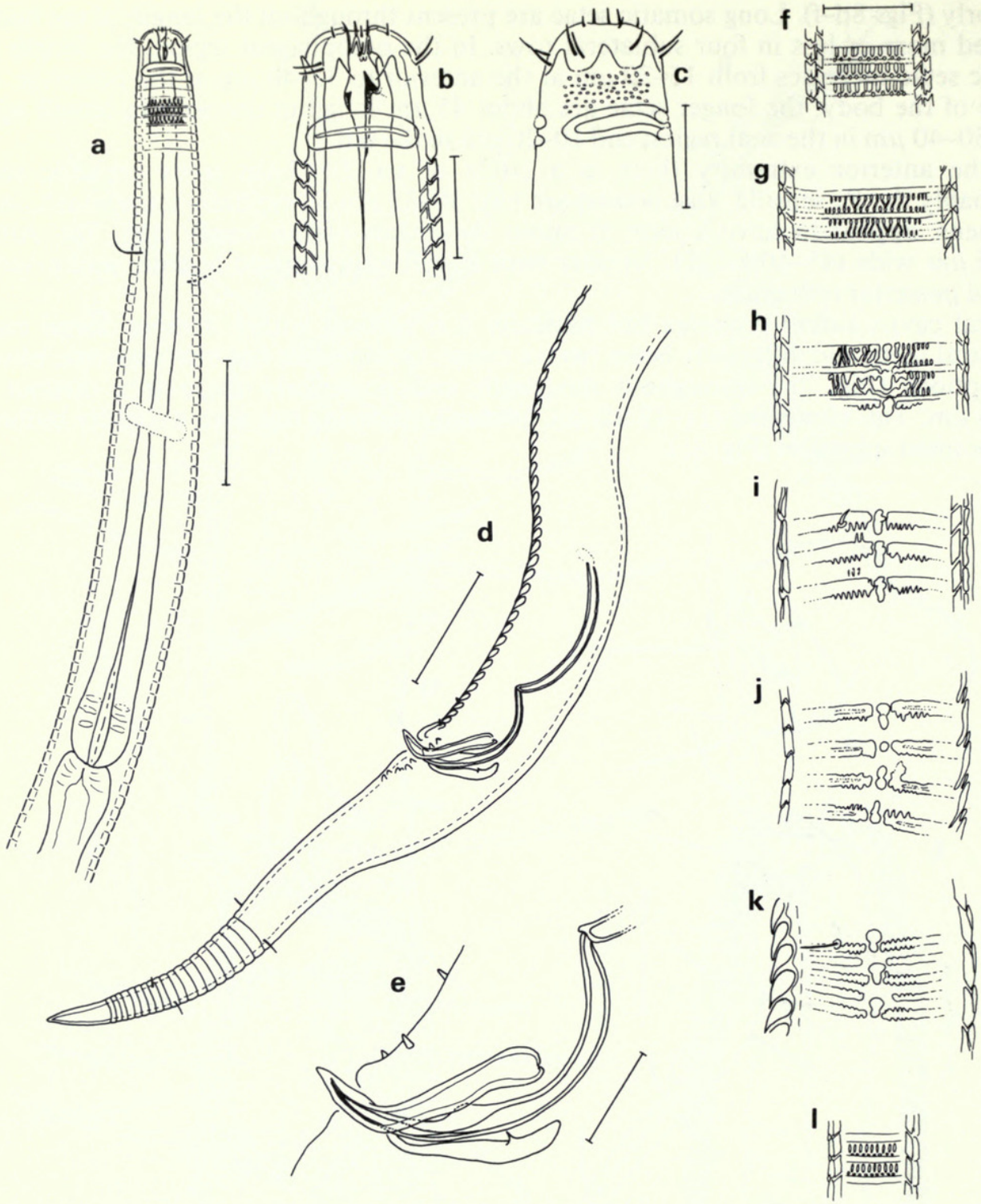

Fig. 9 *Rhips paraornata*: (a) anterior region of ♂$_1$; (b) head of ♂$_1$; (c) head of another ♂; (d) tail of ♂$_1$; (e) copulatory apparatus of ♂$_1$; (f)–(l) cuticle patterns at positions indicated in Fig. 10. Bar scales: a,d = 30 μm; b,c,e–l = 10 μm.

Spicules paired, equal, 26–28 μm long and with a characteristic ventral apophysis. Gubernaculum absent. In ♂$_1$, a feint cuticularised structure was observed lateral to the spicule (Fig. 8b): it was not detected in the other specimens. There is a single stout ventral precloacal seta, 5–6 μm long. Testis single and mature specimens contain large pear-shaped sperm.

Ovary paired, opposed and reflexed. In the female studied, there were sperm present in the oviduct and a large egg in each uterus containing a developing larva.

DIFFERENTIAL DIAGNOSIS. *Acantholaimus ewensis* sp. nov. can be distinguished from *Acantholaimus* species with two lateral longitudinal rows of larger punctations, *A. poly-*

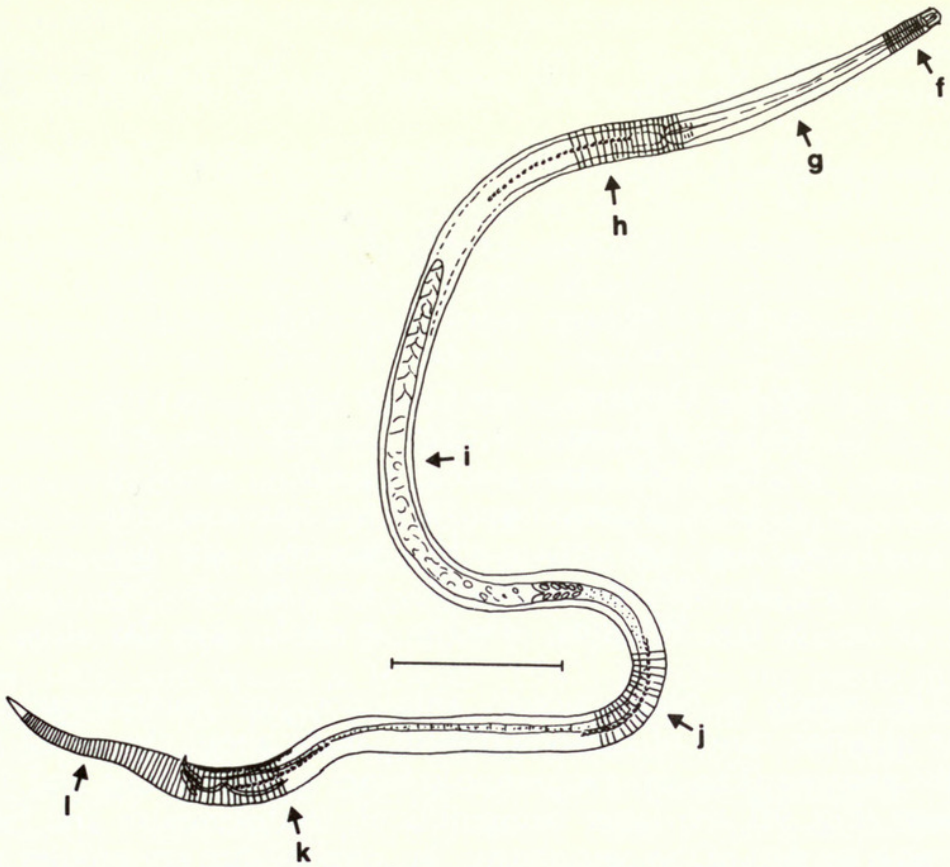

Fig. 10 *Rhips paraornata*: whole body of δ_1 showing positions of cuticle pattern drawings in Fig. 9f–l. Bar scale = 100 μm.

dentatus Gerlach, 1951 and *A. calathus* Gerlach, Schrage & Riemann, 1979, on the length of the R_3 cephalic setae, somatic setae and tail. *A. polydentatus* has shorter cephalic setae (20–22 μm, 1·5 h.d. vs. 30–33 μm; 2·0 h.d.), shorter somatic setae (30 μm, 0·75 c.d. vs. 45 μm, 2·0 c.d.) and a shorter tail (8 a.b.d.vs. 11–12 a.b.d.). *A calathus* has shorter cephalic setae (12 μm, 1·0 h.d.), shorter setae (27 μm, 1·0 c.d.) and longer tail (17 a.b.d.).

DISCUSSION. The genus *Acantholaimus* Allgen, 1933 has been fully revised recently by Gerlach, Schrage & Riemann (1979) who described seven new forms and provided a key to the twelve known species. *A. ewensis* fits into the first part of their key as follows:

1	(4)	Cuticle laterally with two longitudinal rows of larger punctations . . 2
2	(3)	Amphid situated close behind the cephalic setae 2¹
2′	(2″)	Tail 8 anal diameters long *A. polydentatus* Gerlach, 1951.
2″	(2′)	Tail 11–12 anal diameters long *A. ewensis* sp. nov.
3	(2)	Amphid situated half the head diameter behind the cephalic seta. Tail 17 anal diameters long. *A. calathus* Gerlach, Schrage & Riemann, 1979
4	(1)	Cuticle with limited or no lateral differentiation, without longitudinal rows of punctations 5

Rhips paraornata sp. nov.
Figs 9–10

MATERIAL STUDIED. Holotype: δ_1 BM(NH) 1981.4.19.
Allotype: φ_1 BM(NH) 1981.4.20. Paratypes: nine males and two females; δ_6 BM(NH) 1981.4.21, remainder in collection of Z.N.Z.

DIMENSIONS.

Holotype δ_1: $\frac{-\ 180\ M\ 990}{11\ \ 21\ 23\ \ 22}$ 1105 μm; a = 48; b = 6·1; c = 9·6; S = 78 μm

Allotype φ_1: $\frac{-\ 179\ M\ 938}{10\ \ 26\ 29\ \ 20}$ 1080 μm; a = 37; b = 6·0; c = 7·6; V = 54%

δ_2: L = 1085 μm; a = 38; b = 6·1; c = 8·7
δ_3: L = 1330 μm; a = 50; b = 6·5; c = 9·3
δ_4: L = 1130 μm; a = 48; b = 6·5; c = 11·9
δ_5: L = 1260 μm; a = 44; b = 6·4; c = 8·5
δ_6: L = 1260 μm; a = 47; b = 6·9; c = 11·0
δ_7: L = 920 μm; a = 42; b = 5·3; c = 8·7
δ_8: L = 1280 μm; a = 53; b = 6·7; c = 10·0
δ_9: L = 1275 μm; a = 53; b = 7·4; c = 13·0
δ_{10}: L = 1160 μm; a = 50; b = 6·9; c = 9·0
φ_2: L = 1095 μm; a = 44; b = 6·6; c = 9·0
φ_3: L = 980 μm; a = 36; b = 6·5; c = 7·3

DESCRIPTION. The cuticle is conspicuously annulated and heterogeneously ornamented laterally. In the anterior third of the oesophagus, from about the point where the body characteristically narrows (Fig. 9a) each annule bears a row of long and a row of smaller round punctations (Fig. 9f), the latter being difficult to distinguish and liable to be overlooked. In the posterior part of the oesophagus, the punctations are smaller and appear to be partly linked diagonally (Fig. 9g), giving a reticulated appearance. The regular nature of the ornamentation breaks down posterior to the oesophagus and lateral differentiation of large dumb-bell-shaped punctations begins (Fig. 9h). Just posterior to the mid-point of the body, the pattern of the lateral differentiation reverses and, at the point of change, the dumb-bell-shaped lateral punctation is represented by a single round dot (Fig. 9j). Lateral differentiation ends just anterior to the anus and transverse rows of discrete punctations are present on the tail (Fig. 9l).

Short 4–6 μm sublateral somatic setae are present at infrequent intervals throughout the body and at a third of the oesophagus length, there are four longer somatic setae (Fig. 9a). The head bears six setose R_1 sensilla. The six 2–3 μm R_2 sensilla are situated just anterior to the four shorter (1·5–2 μm), R_3 sensilla. The elongated first body annule forms a cephalic shield and bears six triangular flap-like extensions anteriorly which alternate with the $R_2 + R_3$ sensilla (Fig. 9b, c). The shield is irregularly punctated and bears the large transverse amphids. The amphid has strongly cuticularised borders and is 11 μm wide, about 0·85 c.b.d. The buccal cavity is surrounded anteriorly by rugae which protrude beyond the lips. There is a large pointed dorsal tooth and two smaller subventral teeth. The oesophagus widens posteriorly to a weak bulb. The tail is conical and has an unstriated end cone.

The male copulatory apparatus is complex, consisting of two long double-jointed spicules, a paired gubernaculum and two lateral pieces. In the holotype, the posterior part of the spicule measures 40 μm as the arc (or 29 μm as the chord) and the anterior part measures 38 μm as the arc (or 35 μm as the chord). In five other males, the total arc length of the spicule is 70–96 μm. The lateral pieces are about 22 μm long and the gubernaculum 18 μm. The cloacal opening is surrounded by irregular cuticular excrescences and anteriorly there is a small ventral spine. The ventral part of the precloacal body rings are more thickly cuticularised: they gradually reduce in thickness anterior to the level of the proximal end of the spicules (Fig. 9d). There is a single testis situated to the right of the gut. The female has two opposed, reflexed ovaries.

DIFFERENTIAL DIAGNOSIS. *Rhips paraornata* sp. nov. can be distinguished from the only other valid species in the genus, *R. ornata* Cobb, 1920, by having slightly shorter R_2 cephalic setae, wider amphids, spicules with each part about the same length and possibly a differently shaped lateral differentiation.

DISCUSSION. This is only the fifth time that valid specimens of this genus have been reported. Timm (1961) described a species *R. longicauda* from the Bay of Bengal, but the description is very poor and based only on a single immature female: it must be considered a dubious species.

The original description of the type and only other species, *R. ornata*, was by Cobb (1920): the specimens from Loch Ewe are clearly similar to this species from Florida. The species was found again by Wieser & Hopper (1967) who provide a brief redescription and figure the head. Allgen (1932) found what is certainly a male *Rhips* species from Campbell Island and considered it conspecific with Cobb's species and Gerlach (1957) found *R. ornata* in Brazil but did not describe it.

Cobb (1920) described the unusual triangular scale-like cephalic flaps but only saw the four sublateral ones: Wieser & Hopper (1967) correctly observed all six. The four long cervical setae, located at about one-third the oesophagus length in *R. paraornata*, were not reported in *R. ornata* but they are fine and may be lost on handling so that their absence in *R. ornata* cannot be assumed. The four sublateral cephalic flaps were positioned 'just in front of the ends of the amphids' in *R. ornata* according to Cobb (1920) and as figured by Wieser & Hopper (1967), whilst the ends of the amphids in *R. paraornata* extend further beyond the flaps. Both Cobb (1920) and Wieser & Hopper (1967) describe the lateral differentiation in the posterior portion of the body as being 'V'-shaped but unfortunately provide no illustrations of the cuticle patterns. If the lateral differentiation is similar in both species, then we would not have chosen to describe the lateral differentiation as 'V'-shaped. It is possible, then, that the cuticle patterns are different. Finally, the spicules of *R. ornata* have an anterior part which is 1·5 times the length of the posterior part whilst in *R. paraornata* the lengths are almost the same, measured as the arc in both cases. Therefore, although there are many points of similarity in overall dimensions and general anatomy, there are sufficient points of difference in relation to the specific sizes of cephalic setae, amphids and spicules and possibly the form of the cuticle lateral differentiation to substantiate the creation of a new species for the specimens from Loch Ewe.

Species of the genus *Rhips* seem to be very closely related to *Actinonema,* particularly through the excellent redescription of the common species *A. pachydermatum* Cobb, 1920 by Lorenzen (1972): both have similar amphids, cuticle patterns and the six triangular extensions to the cephalic shield, 'Kopfpanzer', although the flaps in *A. pachydermatum* are not as conspicuous as those in *R. paraornatum* and may have been overlooked by earlier workers. However, *Actinonema* does not have large double-jointed spicules and, according to Lorenzen (1972), between those structures which he terms spicules, but which resemble the lateral pieces of *Rhips,* there lies a single thin cuticularised tube which Lorenzen (1972) interprets as the cuticularised terminal portion of the vas deferens. We have studied several specimens of *A. pachydermatum*, sympatric with *R. paraornata*, and find the cuticularised tube very difficult to distinguish. However, in some specimens it is just possible to make out two tubes: if so, they cannot be vas deferens since *A. pachydermatum* is monorchic. This problem is of systematic importance since *Rhips* and *Actinomena*, together with a number of other genera including *Euchromadora,* are grouped together in the subfamily Euchromadorinae. This subfamily was erected by Gerlach & Riemann (1973) without explanation but presumably because of the presence of the 'L'-shaped lateral pieces in addition to spicules and gubernaculum. For *Actinonema* to fit into this group, which seems reasonable through its similarity to *Rhips*, the spicules of *Actinonema* must be considered homologous with the lateral pieces of *Rhips* and either the cuticularised tube(s?) are vestigial spicules or spicules are absent. For the moment, this problem must remain open for further study.

Acknowledgements

We would like to thank Dr A. D. McIntyre of the D.A.F.S. Marine Laboratory, Aberdeen for providing the opportunity for one of us (Z.N.Z.) to spend two years studying benthos at that institute: we named one of our new species in his honour. We would also like to thank the

staff of the benthos section for help, encouragement and the provision of specimens, in particular Dr A. Eleftheriou and Mr D. J. Murison.

References

Allgen, C. 1932. Weitere Beiträge zur Kenntnis der marinen Nematodenfauna der Campbell-insel. *Nyt. Mag. Naturvid.* **70** : 97–198.

—— 1933. Freilebende Nematoden aus dem Trondhjemsfjord. *Capita zool.* **4** : 1–162.

Andrassy, I. 1976. *Evolution as a basis for the systematization of nematodes.* 288 pp. Pitman—London, San Francisco, Melbourne.

Boucher, G. 1975. Nématodes des sables fins infralittoraux de la Pierre Noire (Manche occidentale). I. Desmodorida. *Bull. Mus. natn. Hist. nat. Paris* **285** : 101–128.

Chitwood, B. G. 1936. Some marine nematodes from North Carolina. *Proc. helminth. Soc. Wash.* **3** : 1–16.

Cobb, N. A. 1920. One hundred new nemas (type species of 100 new genera). *Contrib. to a Science of Nematology* **9** : 217–343.

De Coninck, L. A. 1942. Sur quelques espèces nouvelles de Nématodes libres (Ceramonematinae Cobb, 1933), avec quelques remarques de systématique. *Bull. Mus. r. Hist. nat. Belg.* **18:** 1–37.

Filipjev, I. N. 1918. Free-living marine nematodes of the Sevastopol area. *Trudy osob. zool. Lab. Sevastop. biol. Sta.* **4** : 1–350 (in Russian).

Gerlach, S. A. 1951. Drei bemerkenswerte neue Nematoden aus der Kieler Bucht. *Zool. Anz.* **147** : 37–43.

—— 1952. Nematoden aus dem Küstengrundwasser. *Abh. math. -naturw. Kl. Akad. Wiss. Mainz* **6** : 315–372.

—— 1956. Diagnosen neuer Nematoden aus der Kieler Bucht. *Kieler Meeresforsch.* **12** : 85–109.

—— 1957. Die Nematodenfauna des Sandstrandes an der Küste von Mittelbrasilien (Brasilianische Meeres-Nematoden IV). *Mitt. zool. Mus. berl.* **33** : 411–459.

—— 1963*a*. Freilebende Meeresnematoden von den Maldiven II. *Kieler Meeresforsch.* **14** : 67–103.

—— 1963*b*. *Robbea tenax* sp. n., ein merkwürdiger mariner Nematode von den Maldiven. *Int. Revue ges. Hydrobiol. Hydrogr.* **48** : 153–158.

—— **& Riemann, F.** 1973. The Bremerhaven checklist of aquatic nematodes. A catalogue of Nematoda Adenophorea excluding the Dorylaimida. *Veröff. Inst. Meeresforsch. Bremerh.* Suppl. 4 : 1–404.

——, **Schrage, M. & Riemann, F.** 1979. Die Gattung *Acantholaimus* (Nematoda, Chromadoridae), und Beobachtungen über einen mutmasslichen Transportmechanismus für Spermien bie *A. calathus* sp. n. *Veröff. Inst. Meeresforsch. Bremerh.* **18** : 35–67.

Haspeslagh, G. 1973. Superfamille des Ceramonematoidea (Cobb, 1933) (Nematoda), évolution et systématique. *Annls Soc. r. zool. Belg.* **102** : 235–251.

Hopper, B. E. & Cefalu, R. C. 1973. Free-living marine nematodes from Biscayne Bay, Florida V. Stilbonematinae: contributions to the taxonomy and morphology of the genus *Eubostrichus* Greef and related genera. *Trans. Am. microsc. Soc.* **94** : 578–591.

Inglis, W. G. 1968. Interstitial nematodes from St. Vincent's Bay. New-Caledonia. *Editions Fondat. Singer-Polignac, Paris, 1967* **2** : 29–74.

Lorenzen, S. 1972. Die Nematodenfauna im Verklappungsgebiet für Industrieabwasser nordwestlich von Helgoland II. Desmodorida und Chromadorida. *Zool. Anz.* **187** : 283–302.

—— 1981. Entwurf eines phylogenetischen Systems der freilebenden Nematoden. *Veröff. Inst. Meeresforsch. Bremerh.* Suppl. 7 : 1–472.

McIntyre, A. D. & Eleftheriou, A. 1968. The bottom fauna of a flatfish nursery ground. *J. mar. biol. Ass. U.K.* **48** : 113–142.

—— **& Murison, D. J.** 1973. The meiofauna of a flatfish nursery ground. *J. mar. biol. Ass. U.K.* **53** : 93–118.

Platt, H. M. 1973. Freeliving marine nematodes from Strangford Lough, Northern Ireland. *Cah. Biol. mar.* **14** : 295–321.

Steele, J. H. & Baird, I. E. 1968. Production ecology of a sandy beach. *Limnol. Oceanogr.* **13** : 14–25.

Timm, R. W. 1961. The marine nematodes of the Bay of Bengal. *Proc. Pakist. Acad. Sci.* **1** : 1–88.

Vitiello, P. 1974. Nouvelles espèces de Desmodorida (Nematoda) des côtes de Provence. *Téthys* **5** : 137–146.

Wieser, W. 1959. *Free-living nematodes and other small invertebrates of Puget Sound beaches.* 179 pp. University of Washington Press, Seattle.

—— **& Hopper, B.** Marine nematodes of the east coast of North America. *Bull. Mus. comp. Zool. Harv.* **135** : 239–244.

Manuscript accepted for publication 14 September 1981